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Abstract

Purpose: This study quantified the frequencies and timings of rugby union match-play phases (i.e., attacking, defending, ball in play (BIP) and ball out of play (BOP)) and then compared the physical characteristics of attacking, defending and BOP between forwards and backs.

Methods: Data were analysed from 59 male rugby union academy players (259 observations). Each player wore a micro-technology device (Optimeye S5, Catapult) with video footage analysed for phase timings and frequencies. Dependent variables were analysed using a linear mixed-effects model and assessed with magnitude-based inferences and Cohen's *d* effect sizes (ES).

Results: Attack, defence, BIP and BOP times were 12.7 ± 3.1 , 14.7 ± 2.5 , 27.4 ± 2.9 and 47.4 ± 4.1 min, respectively. Mean attack (26 ± 17 s), defence (26 ± 18 s) and BIP (33 ± 24 s) phases were shorter than BOP phases (59 ± 33 s). The relative distance in attacking phases was similar (112.2 ± 48.4 vs. 114.6 ± 52.3 m·min⁻¹, ES = 0.00 ± 0.23) between forwards and backs, while greater in forwards (114.5 ± 52.7 vs. 109.0 ± 54.8 m·min⁻¹, ES = 0.32 ± 0.23) during defence and greater in backs during BOP (ES = -0.66 ± 0.23).

Conclusion: Total time in attack, defence and therefore BIP was less than BOP. Relative distance was greater in forwards during defence, while greater in backs during BOP and similar between positions during attack. Players should be exposed to training intensities from in play phases (i.e., attack and defence) rather than whole-match data and practice technical skills during these intensities.

Keywords: Physical preparation; Player development; GPS; Skill involvements; Contact sports

Introduction

The physical characteristics of match-play (i.e., running and collisions) in age-grade (e.g., U18) rugby union players is a growing area of research.¹⁻³ Studies using global positioning systems (GPS) have published data from county representative,⁴ school,⁵ academy² and international competition.³ Read and colleagues² showed that U18 academy backs covered more distance (5639 ± 368 vs. 5461 ± 360 m, effect size (ES) = 0.67) and achieved greater maximum speeds (8.1 ± 0.4 vs. 7.0 ± 0.7 m·s⁻¹, ES = 1.08) during match-play compared to forwards. The differences between positions corroborate similar findings from senior rugby union.⁶ The lower locomotor activities in forwards are likely because of the higher collision rates (0.56 ± 0.23 vs. 0.36 ± 0.17 n·min⁻¹, ES = 0.99),⁷ differences in player physical characteristics^{8,9} and tactical roles they undertake¹⁰ compared to backs. These findings collectively lead to the common belief that for backs, the physical characteristics of rugby union are dominated by running. However, these data are typically reported as a mean or total from a whole match and due to the stoppages in team sports are likely to underestimate the intensity of match-play when the ball is in play, which could also lead to players being unprepared for the most intense periods of play.¹¹

The demands of match-play have been categorised using different methods, for example, time when the ball is in play (BIP) and when the ball is out of play (BOP).¹⁰ Senior rugby union international matches in 1992 had a mean BIP time of 29 min over an 80 min game, while the mean and maximum BIP cycle were 19 and 70 s, respectively.¹² Further research has highlighted a trend for an increase in BIP time between 2000 and 2002 to approximately 31 min¹³ and again to 36.3 ± 2.7 min between 2004 and 2010.¹⁰ However, BIP can also be further split into attacking and defensive phases for rugby union which often occur in isolation without the transition between attack and defence and therefore are often trained separately. Despite this, little is known about the frequencies or timings of these phases of play, or the overall physical characteristics of each phase. Previously, a study in rugby league quantified the locomotor characteristics of attacking and defending and highlighted that relative distance was greater while defending (109 ± 16 vs. 82 ± 12 m·min⁻¹, ES = 1.35).¹⁴ Despite this, the study only reported data from forwards in senior rugby league and thus the applicability for age-grade rugby union players is limited.

In England, age-grade rugby union players can participate in several playing standards (e.g., amateur club, school and representative) concurrently, with academy rugby perceived to

be the highest standard besides international competition.¹⁵ Academy rugby is the final step before age-grade international and professional rugby and therefore sport scientists and strength and conditioning coaches require information on the most demanding phases of play to appropriately prepare players. Therefore, the aim of the study was to quantify and compare the physical characteristics of the three phases of play; attacking, defending and BOP between forwards and backs during academy rugby union match-play.

Methods

Participants

Fifty-nine male rugby union players were recruited from a regional academy. The participants were split by position; forwards (age: 17.5 ± 0.6 years; stature: 185.9 ± 5.7 cm; body mass: 95.0 ± 8.9 kg) and backs (age: 17.7 ± 0.6 years; stature: 180.3 ± 5.2 cm; body mass: 81.8 ± 10.5 kg). There were repeated measurements of individual participants and therefore 259 observations were collected (mean \pm standard deviation (SD); 4 ± 3 observations per player). The repeated measurement of participants if appropriately accounted for and outlined in the statistical analysis.¹⁶ Ethics approval was granted from Leeds Beckett University institutional ethics committee and adhered to throughout. Written informed consent was gained from all participants prior to starting the study, with a parent or guardian providing this for participants under the age of 18.

Design

The study used an observational research design whereby data were collected during competitive matches from the regional academy annual league during the 2014/2015 and 2015/2016 seasons, totalling 12 matches. In England, the 14 regional academies are split into two groups of seven (north and south leagues), meaning each academy plays six competitive matches per year. Therefore, this study consists of two full seasons data. Of the 12 matches, there were an equal number of home and away fixtures, with a mean points scored and conceded per game of 12 ± 10 and 30 ± 10 . Matches at the U18 age-grade are 70 min in length.

Methodology

Video footage from the matches was obtained (AX100 4K Camcorder, Sony, Tokyo, Japan) and analysed manually for attacking, defending, BIP and BOP timings. Attacking phases were defined as when the team under investigation were in

possession of the ball, whereas when the opposition were in possession this was classified as a defensive phase. The referee blowing the whistle was used to signify the beginning of a BOP period (e.g., try scored, penalty awarded).¹⁴ When kicks into touch were made, the raising of the flag from the assistant referee was used to signify the beginning of a BOP period. Instances where a team restarted play within 5 seconds or less after being awarded a penalty were not considered as a BOP phase.¹⁷ When a scrum occurred, the BOP phase ended with the call of 'set' from the referee, as this is the point at which the front rowers of both teams engage in physical contact.¹³

The total number of phases and total time spent in attacking, defending, BIP and BOP phases were recorded. The mean, mean of the maximum, maximum and minimum cycle time for the three phases were analysed in addition to a frequency distribution of each cycle based on the following classifications: 0-15, 16-30, 31-45, 46-60, >60 s.¹⁷ In order to assess inter-rater reliability of the video analysis, the time spent in attack and defence was analysed by a second trained individual. The coefficient of variation $\pm 90\%$ confidence intervals (CI) for attack, defence and BOP was $1.98 \pm 0.80\%$, $1.17 \pm 0.70\%$ and $1.52 \pm 0.72\%$, respectively.

During the match, each player wore a micro-technology device (Optimeye S5, Catapult, Melbourne, Australia) that contained a GPS system sampling at 10 Hz and a tri-axial accelerometer, gyroscope and magnetometer sampling at 100 Hz. The devices were fitted in a vest provided by the manufacturer and worn under the playing shirts. The devices were switched on outside at the start of the warm up and switched off at the end of the match. However, each file was trimmed so it only contained data from actual playing time for each participant. Similar GPS units have shown acceptable validity and reliability for measuring movements that are common during team sport match-play.¹⁸ The accelerometer used in the current study has also been shown to have an acceptable CV for within (0.9–1.1%) and between (1.0–1.1%) unit reliability.¹⁹ The mean \pm SD number of satellites connected during all data collection was 14.5 ± 0.9 , while the horizontal dilution of precision was 0.69 ± 0.13 .

The timings of attack, defence and BOP phases were synchronised and manually entered into the GPS software (Sprint 5.1.7, Catapult, Melbourne, Australia). Relative distance ($\text{m} \cdot \text{min}^{-1}$) was downloaded to assess the locomotor characteristics of match-play. PlayerLoadTM per minute ($\text{PL} \cdot \text{min}^{-1}$) ($\text{AU} \cdot \text{min}^{-1}$) was downloaded to quantify the additional external load such as accelerations that rugby players experience. PL is a vector magnitude and sums the frequency

and magnitude of accelerations in the three axial planes.²⁰ A very large ($r = 0.79$) relationship between PL and collisions in rugby union has previously been shown, although it is acknowledged this measure is limited in its ability to distinguish between actions.²¹

227

228 *Statistical Analyses*

229

230 All estimations were made using the *lme4* package with R
231 (version 3.3.1, R Foundation for Statistical Computing, Vienna,
232 Austria). A linear mixed-effects model was used to model the
233 main and interactive effects of phase of play (attacking,
234 defending, and BOP), positional group (forwards and backs)
235 and time classification (0-15, 16-30, 31-45, 46-60 and >60 s)
236 upon match-play physical characteristics (relative distance and
237 PL·min⁻¹). Dependent variables were log transformed before
238 modelling, and then effects and standard deviations were back-
239 transformed to percentages. The random-effects in the model
240 were match identity (differences between mean match demands
241 not accounted for by the fixed-effects), athlete identity
242 (differences between athletes' mean locomotor characteristics)
243 and the residual (within-athlete and match-to-match
244 variability). Magnitude-based inferences were applied using the
245 estimates from the linear mixed model (representing percentage
246 differences between the levels of the fixed effects) and were
247 compared against a smallest worthwhile effect threshold
248 equivalent to 0.2 of the between-subject standard deviations
249 (relative distance = 4.7% and PL·min⁻¹ = 4.9%) using a
250 spreadsheet.²² Effects were classified as *unclear* if the
251 percentage likelihood that the true effect was positive and
252 negative were both >5%. Otherwise, the effect was deemed
253 clear, and was qualified with a probabilistic term using the
254 following scale: <0.5%, *most unlikely*; 0.5-4.9%, *very unlikely*;
255 5-24.9%, *unlikely*; 25-74.9%, *possible*; 75-94.9%, *likely*; 95-
256 99.5%, *very likely*; >99.5%, *almost certainly*.²³ Cohen's *d* ES
257 are shown ±90% CI.

258

259 **Results**

260

261 A breakdown of the attacking, defending, BIP and BOP phases
262 are shown in Table 1.

263

264 *** INSERT TABLE ONE NEAR HERE ***

265

266 The distributions for all time classifications in attack (A),
267 defence (B), BIP (C) and BOP (D) are shown in Figure 1. The
268 frequency distribution was the greatest in the 0-15 and 16-30 s
269 classifications for both attacking (31.9 ± 6.2 and $39.2 \pm 7.1\%$)
270 and defending (30.0 ± 8.3 and $40.0 \pm 7.0\%$). While 16-30 s

(31.7 ± 5.8%) and >60 s (39.7 ± 9.5%) had the greatest distribution during BIP and BOP phases, respectively.

*** INSERT FIGURE ONE NEAR HERE ***

Figure 2 presents the relative distance (A) and PL·min⁻¹ (B) for the three phases of play and two positions. The difference in relative distance in attacking phases of play was *unclear* (ES = 0.00 ± 0.23) between forwards (112.2 ± 48.4 m·min⁻¹) and backs (114.6 ± 52.3 m·min⁻¹), while measures during defending were *likely* (ES = 0.32 ± 0.23) greater in forwards (114.5 ± 52.7 m·min⁻¹) compared to backs (109.0 ± 54.8 m·min⁻¹). During BOP time backs (54.3 ± 29.2 m·min⁻¹) were *almost certain* (ES = -0.66 ± 0.23) to have a greater relative distance than forwards (47.7 ± 27.5 m·min⁻¹). The difference in PL·min⁻¹ was *almost certainly* greater in forwards during both attacking (12.6 ± 5.0 vs. 12.0 ± 6.7 AU·min⁻¹, ES = 0.76 ± 0.33) and defending (12.8 ± 5.2 vs. 11.0 ± 6.3 AU·min⁻¹, ES = 1.19 ± 0.33) phases than backs. The difference in PL·min⁻¹ was *unclear* during BOP (4.2 ± 2.4 vs. 4.3 ± 3.0 AU·min⁻¹, ES = 0.12 ± 0.33) time between the two positions.

Within the forwards group, the difference in attacking and defending was *likely trivial* for relative distance (ES = 0.07 ± 0.19) and PL·min⁻¹ (ES = 0.02 ± 0.18). Within the backs group, the difference in attack phases were *likely* greater compared to defence phases for relative distance (ES = 0.39 ± 0.22) and PL·min⁻¹ (ES = 0.41 ± 0.22).

*** INSERT FIGURE TWO NEAR HERE ***

The relative distance for each time classification, position and phase of play is presented in Table 2. Differences between positions are analysed for each time classification and phase of play. In attack, the difference in relative distance during 31-45 s phases was *possibly* lower (ES = -0.23 ± 0.37) in forwards (118.3 ± 35.6 m·min⁻¹) than backs (124.2 ± 39.2 m·min⁻¹). All other attack comparisons were *unclear*. In defence, forwards were *possibly* (ES = 0.24 ± 0.34) to *very likely* (ES = 0.53 ± 0.33) greater than backs at all time classifications. During BOP, forwards were *possibly* (ES = -0.32 ± 0.34) to *very likely* (ES = -0.36 ± 0.11) lower than backs at all time classifications.

*** INSERT TABLE TWO NEAR HERE ***

Discussion

The aim of the study was to quantify and compare the physical characteristics of the three phases of play (i.e., attacking, defending and BOP) between forwards and backs during

academy rugby union match-play. The results highlight that less than half of the match is spent with the BIP (37%), while the mean time for phases in attack (26 ± 17 s), defence (26 ± 18 s) and BIP (33 ± 24 s) are lower than BOP (59 ± 33 s). This is the first study to show that relative distance during attacking phases was similar between forwards and backs, while forwards had a greater relative distance during defensive phases. In contrast, during BOP phases relative distance was greater in backs than forwards. Based on whole match data, previous studies^{2,6,10} have reported backs to cover greater distances during a match, whereas this study shows that forwards cover more distance per minute in defence and were similar to backs in attack. These data provide new information for applied practitioners working in rugby union and can be used to prepare players for the specific phases of play.

Senior international rugby union match-play has a greater BIP (36.3 ± 2.7 vs. 27.4 ± 2.9 min) and BOP (53.5 ± 5.5 vs. 47.4 ± 4.1 min) time than the current study, as U18 matches in England last 70 min in comparison to 80 min at the senior level.¹⁰ However little information exists on the attack and defence timings in rugby union. Differences between rugby league and union are evident in the mean length of attacking (40 ± 6 vs. 26 ± 17 s) and defending (40 ± 6 vs. 26 ± 18 s) phases, while the BOP (48 ± 4 vs. 59 ± 33 s) phases were longer in the current study.²⁴ Differences between rugby codes are likely because of the additional stoppages in rugby union for events such as lineouts and scrums, but could also be attributed to the participants used by Sykes et al.²⁴, as differences between standards (e.g., U18 vs. professional) are unknown. Based on the mean BIP, attack and defence cycles, it may be questioned whether academy matches are demanding enough to challenge players with the most potential to progress toward the senior professional pathway. Match-play represents the greatest opportunity for players to develop skills under pressure against opposition and therefore BIP time should be maximised for age-grade players. Caution is advised when extrapolating these data to an entire league as it is taken from one team and previous research has highlighted that top 4 teams in the NRL have longer BIP cycles than the bottom 4 teams in the same league.²⁵ Future studies should look to incorporate data from multiple teams to negate this issue.

In the current study, the frequency distributions of attacking and defensive phases were weighted towards the shorter classifications (0-15 and 16-30 s), while BOP phases were concentrated towards the longer classifications (31-45 and >60 s). It should be noted that several attack and defence phases could occur in between BOP phases, and therefore on occasions might be longer than the BOP phase. However, the

BIP time was still relatively low (27.4 ± 2.9 min; 37%) in the context of a whole match, with each BIP cycle lasting an mean of 33 s, only 7 s longer than the mean attack and defence phase highlighting the need for this type of analysis. Previous research has reported that BIP cycles were longer during international sevens competition compared to provincial matches and this was related to skill execution (e.g., fewer handling errors).¹⁷ The impact of skill execution on BIP time is currently unknown within this cohort but future research should investigate this, as it would provide further insight into rugby union match-play and has potential implications for player development.

A previous conception of rugby union is that for backs the game is dominated physically by running, however the current study questions this. In attack, the difference in relative distance was *unclear* between the two positional groups, but *likely* greater in forwards during defence. It is unknown if the preparation of this specific team impacted this. It is acknowledged the use of relative distance is a limitation and the inclusion of high-speed running would have provided further insight. However, it is also generally accepted that as players get older more position specific skills are practiced, physical characteristics develop^{8,26} and therefore the physical characteristics of age-grade matches might not always reflect the same pattern as the senior game.^{4,5}

The mean relative distance ranged from $109.0 - 114.6 \text{ m} \cdot \text{min}^{-1}$ in attack and defence for the current study, which is substantially higher than mean match data ($71.7 - 74.0 \text{ m} \cdot \text{min}^{-1}$) from regional academy players.² The mean values for attack and defence are within the range presented by Tierney et al.²⁷ during entries into the attacking 22 m area for front row props ($97.5 \text{ m} \cdot \text{min}^{-1}$) and scrum halves ($121.0 \text{ m} \cdot \text{min}^{-1}$). However, research from Delaney et al.²⁸ has shown the peak running intensities of international rugby union match-play to be as high as $175 \pm 22 \text{ m} \cdot \text{min}^{-1}$ for a 1 min rolling mean. Furthermore, previous research has indicated that there is a drop in distance covered and skill involvements from less experienced, younger players following an intense period of play compared to more experienced, older players.²⁹ Therefore, coaches should expose age-grade players to peak running intensities during training to increase their ability to sustain physical and technical output following intense periods of play in preparation for senior rugby. In addition, the difference in $\text{PL} \cdot \text{min}^{-1}$ was *almost certainly* greater in forwards during attacking and defending, which is likely representative of the greater amount of running, carries, tackles and rucks entered and should be considered when designing training practices.¹⁰

421 A novel finding of this study was that backs covered an *almost*
422 *certainly* greater relative distance than forwards during BOP
423 time. It is hypothesised this is because backs reposition around
424 the pitch while forwards are waiting for the match to restart
425 (e.g., lineouts, scrums, etc). Future research should investigate
426 if the current findings are replicated in senior players or if this
427 is specific to age-grade players, as this would potentially
428 change the current understanding of the locomotor
429 characteristics for forwards and backs and inform the physical
430 preparation of players.

431
432 It is also important to understand how the phases of play
433 compare within the same position as this has potential
434 implications for the way coaches prepare specific positional
435 groups. For forwards, the difference between attacking and
436 defending for both relative distance and $PL \cdot min^{-1}$ was *likely*
437 *trivial* and therefore preparation for these two phases of play
438 can be similar in physical characteristics. In contrast, backs had
439 a *likely* greater difference in relative distance and $PL \cdot min^{-1}$ in
440 attack compared to defence, which indicates attacking play is
441 the most demanding phase of play for backs. This suggests
442 backs are involved in more of the play in attacking situations
443 than defensive, which has previously been shown in junior
444 rugby league³⁰. The use of data from specific phases of play
445 provides context to the preparation of rugby players, in that
446 training is often focussed on these phases. Despite that, this
447 type of analysis could underestimate the true worse case
448 scenario, as this could come from BIP action that involves both
449 attacking and defending and is acknowledged as a limitation to
450 the study. The quantification of the peak running intensities
451 using a rolling mean of the instantaneous velocity would
452 encapsulate these periods.

453 454 **Practical Applications**

455
456 Players should be exposed to training that uses intensities from
457 in play phases (i.e., attack and defence) rather than means from
458 whole match data. Coaches should incorporate this into rugby
459 training to ensure that executions of technical skills are
460 practiced during these intensities. Age-grade rugby coaches
461 should use the timings provided in Table 1 to appropriately
462 manipulate training and where possible place conditions on
463 match-play to increase BIP time in preparation for players
464 progressing to professional rugby.

465 466 **Conclusions**

467
468 This study quantifies and compares the physical characteristics
469 of attacking, defending, BIP and BOP phases during academy
470 rugby union match-play. The current study is the first to

471 provide reference values for specific phases of match-play in
472 academy rugby union, with values for attacking and defending
473 substantially greater than previously reported whole match
474 data. While the game of rugby union requires all positions to
475 undertake many roles and responsibilities, backs roles are
476 predominately described as locomotor based (i.e., high speed
477 running, greater total distance). However, novel findings in the
478 current study show that forwards covered more distance per
479 minute when in defence while the backs covered more during
480 BOP time. The greater $PL \cdot min^{-1}$ in forwards likely represents
481 the more actions they undertake which have been shown in
482 notational analysis studies. As noted in previous studies, the
483 ball is in play for a low percentage of time with the mean
484 attacking and defending phase as low as 26 s. Therefore,
485 policy-makers should consider the impact of competition
486 demands at an age-grade (academy) level upon player
487 development, and consider opportunities to modify laws or
488 game formats to allow greater development opportunities.

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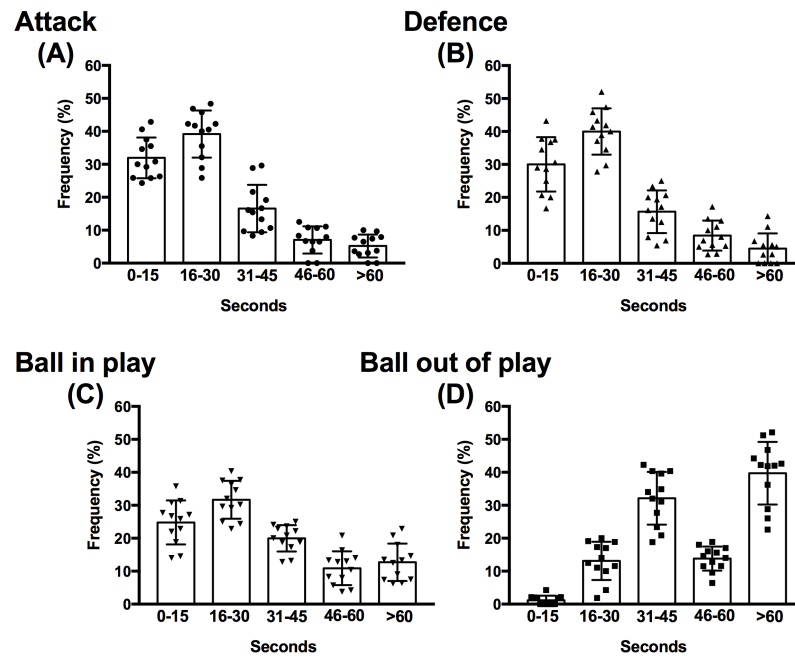


Figure 1. The distribution times of attack (A), defence (B), ball in play (C) and ball out of play (D) phases during academy rugby union match-play

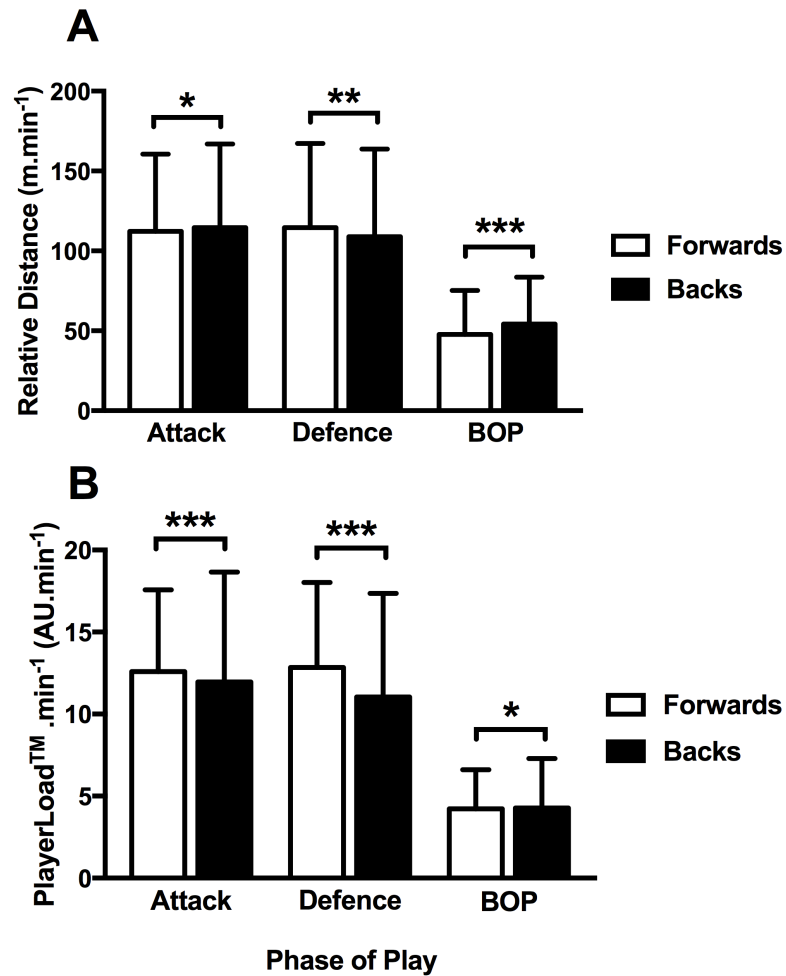


Figure 2. Relative distance (A) and PL·min⁻¹ (B) of attacking, defending and ball out of play phases during academy rugby union match-play for forwards and backs. * = *Trivial* effect size (<0.20), ** = *Small* effect size (0.20-0.59), *** = *Moderate* effect size (0.60-1.20)

Table 1. Attacking, defending, BIP and BOP phases during academy rugby union match-play

	Attacking	Defending	Ball in play	Ball out of play
Time (min, %)	12.7 ± 3.1 (17%)	14.7 ± 2.5 (20%)	27.4 ± 2.9 (37%)	47.4 ± 4.1 (63%)
Phases (<i>n</i>)	27 ± 9	31 ± 10	49 ± 4	48 ± 3
Mean Phase Time (s)	26 ± 17	26 ± 18	33 ± 24	59 ± 33
Mean Maximum Phase Time (s)	73 ± 14	79 ± 18	103 ± 35	142 ± 60
Maximum Phase Time (s)	96	113	149	259
Minimum Phase Time (s)	7	7	7	9

Data are presented as mean ± standard deviation. BIP = Ball in play. BOP = Ball out of play.

Table 2. Relative distance for forwards and backs in 0-15, 16-30, 31-45, 46-60 and >60 s classification times during academy rugby union match-play

Time Classification	Position	Attack		Defence		Ball out of play	
		(m·min ⁻¹)	MBI; ES ±CI	(m·min ⁻¹)	MBI; ES ±CI	(m·min ⁻¹)	MBI; ES ±CI
0-15 s	Forwards	103.3 ± 62.2	<i>Unclear</i>	109.4 ± 67.1	<i>Possibly</i> ↑	72.0 ± 29.3	<i>Possibly</i> ↓
	Backs	102.0 ± 64.2	0.08 ±0.41	106.5 ± 68.6	0.24 ±0.34	86.4 ± 37.2	-0.32 ±0.34
16-30 s	Forwards	115.9 ± 44.8	<i>Unclear</i>	118.4 ± 52.5	<i>Very Likely</i> ↑	65.0 ± 36.6	<i>Likely</i> ↓
	Backs	118.3 ± 50.4	-0.02 ±0.25	110.5 ± 54.5	0.53 ±0.33	73.0 ± 39.3	-0.25 ±0.13
31-45 s	Forwards	118.3 ± 35.6	<i>Possibly</i> ↓	117.4 ± 35.5	<i>Likely</i> ↑	48.2 ± 27.8	<i>Very Likely</i> ↓
	Backs	124.2 ± 39.2	-0.23 ±0.37	113.2 ± 41.1	0.37 ±0.40	56.6 ± 28.7	-0.36 ±0.11
46-60 s	Forwards	116.9 ± 28.6	<i>Unclear</i>	112.6 ± 30.9	<i>Likely</i> ↑	47.4 ± 24.3	<i>Likely</i> ↓
	Backs	121.9 ± 33.4	-0.19 ±0.52	106.7 ± 34.3	0.40 ±0.49	55.0 ± 26.5	-0.32 ±0.13
>60 s	Forwards	112.7 ± 23.3	<i>Unclear</i>	108.4 ± 20.9	<i>Possibly</i> ↑	40.7 ± 20.6	<i>Likely</i> ↓
	Backs	118.7 ± 29.8	-0.21 ±0.56	102.0 ± 28.2	0.44 ±0.59	45.0 ± 21.1	-0.20 ±0.10

Data are presented as mean ± standard deviation. MBI = Magnitude-based inferences. ES = Effect size. CI = Confidence interval (90%).

↑ = Forwards are greater than backs. ↓ = Forwards are lower than backs.